

Abstract of Invention

A bi-functional oxidation catalyst and process for catalytic oxidation and removal of nitrogen oxides (NO_x) from combustion gases derived from combustion of carbonaceous fuels such as coal, oil, or natural gas. The bi-functional catalyst includes adsorption and oxidation function metal oxides provided in adjacent close intimate contact by utilizing a binding agent, such as carboxylic acid and calcining to provide a metal oxide complex having a crystalline form. Such nitrogen oxides (NO_x) contained in the combustion gases are initially catalytically oxidized to at least about 50 vol % NO_2 and some higher oxides by contact with the bi-functional catalyst at 170-550°F temperature. The combustion gas containing the partially oxidized NO_x is then preferably further chemically oxidized by being mixed with a chemical oxidant such as ozone (O_3) in a molar ratio of the chemical oxidant, to NO_x in the range of 0.5:1-1.2:1 to produce higher oxides of nitrogen such as substantially N_2O_5 . The further treated combustion gas containing the N_2O_5 is next scrubbed with a suitable scrubbing liquid such as water to effectively remove the nitrogen oxides (NO_x) and produce a clean treated flue gas stream containing less than about 15 ppm nitrogen oxides and suitable for environmentally safe discharge to the atmosphere.